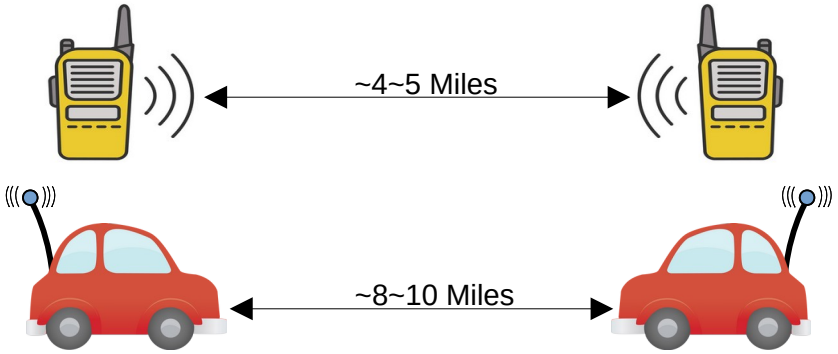
How far Can I Transmit with My GMRS Radio?
(Part I of III Parts)

Here is a handy chart giving **approximate maximum** ranges for GMRS radio transmission distance.

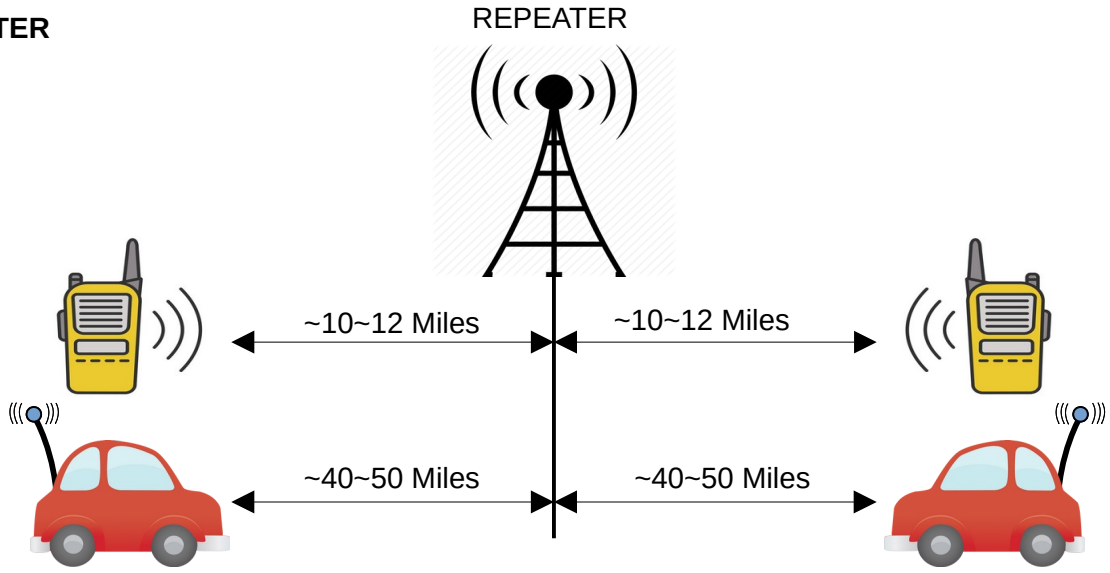
GMRS Radio	Mode	Distance
Handheld to Handheld	FM Simplex	~ 5 Miles (maybe)
Handheld thru Repeater to Handheld	FM Simplex	~10 – 12 Miles (Handheld limits range)
Mobile to Mobile	FM Simplex	~ 25 Miles (maybe)
Mobile thru Repeater to Mobile	FM Simplex	~ 55 Miles

Your mileage may vary depending upon height above average terrain, terrain variations, vegetation, and atmospherics, see Page 2 and also explained with detail in Part II.

SIMPLEX



REPEATER



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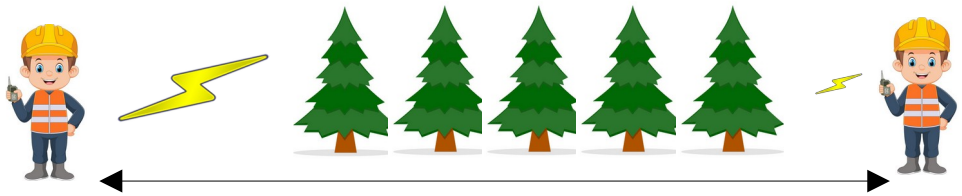
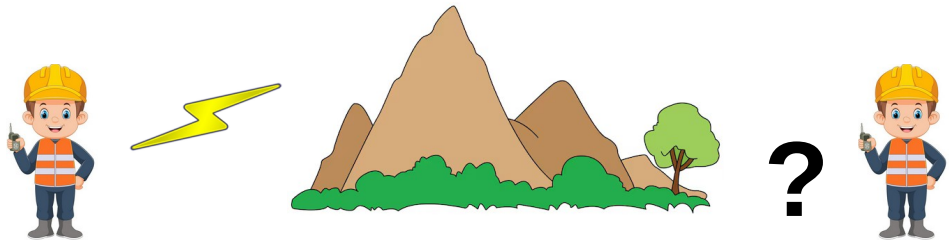
Forests



Hills or Mountains



Why are there distance limitations?

"All radio signals diminish between stations as distance increases"

Many factors must be considered when discussing transmission distance for GMRS communications. This is a brief explanation how nominal transmission distance is determined by studying relevant factors.

> The GMRS radio service, as regulated in the United States by the FCC, is a frequency modulated (FM) radio service in the UHF, 462.570 MHz to 462.7250 MHz and 467.5500 MHz to 467.7250 MHz range. **This discussion and accompanying explanations shall be limited to that frequency range and modulation type.** Other frequency ranges and modulation types require a slightly different explanations. However, the basic theory is constant throughout.

DISTANCE FACTORS

There are four positive factors, ***determined mostly by the operator,*** which affect transmission distance *(Over smooth earth, unobstructed paths)*:

1. **Transmitter power** - more power equals greater distance.
2. **Antenna Height** - the higher the antennas equals greater distance.
3. **Coaxial feed-line loss** - choosing a coax with less loss-per-foot and shorter coax length equals greater transmission efficiency, thus greater distance.
4. **Antenna Gain** – The greater the antenna gain, the greater the transmission distance.

There are many negative factors over which ***the operator has little, to no, control***. These major considerations are: *(Further explanations are in Part II.)*

1. **Distance** between radios
2. **Terrain obstructions**, such as, buildings, ridges/hills/mountains, forests and other vegetation
3. **Propagation anomalies**, such as ionospheric and atmospheric changes particular to UHF
4. **Interference and Noise,** and receiver noise figure, receiver bandwidth, minimum discernible receive signal level, local ambient noise interference, co-channel and adjacent channel interference (and several other technical considerations)

"GMRS UHF radio waves travel farther than visual (optical) LOS"

LINE-OF-SIGHT (LOS)

Visual (optical) line-of-sight (LOS) differs from radio line-of-sight. Visual LOS is that which can be seen optically over smooth earth of a constant radius – think Death Valley, CA, or Bonneville Salt Flats, Utah. Radio LOS is a little bit further than visual LOS due to atmospheric diffraction, or slight "bending", of the radio wave so that it follows the earths curvature. Yes, that's correct, VHF and UHF radio waves travel slightly farther than visual *(optical)* LOS.

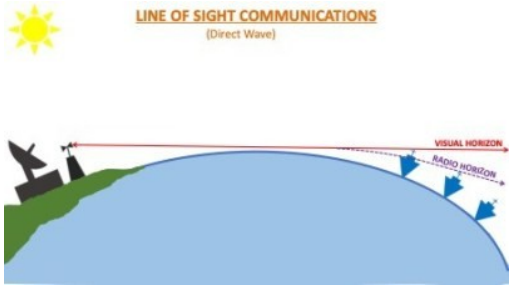


Figure 1: Figure 1. Radio Line of Site

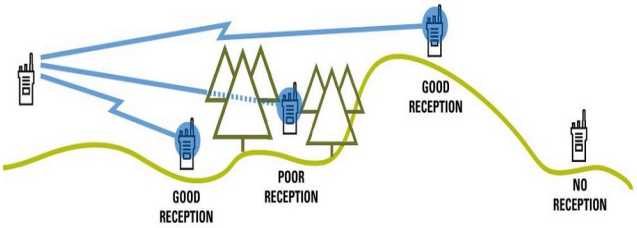
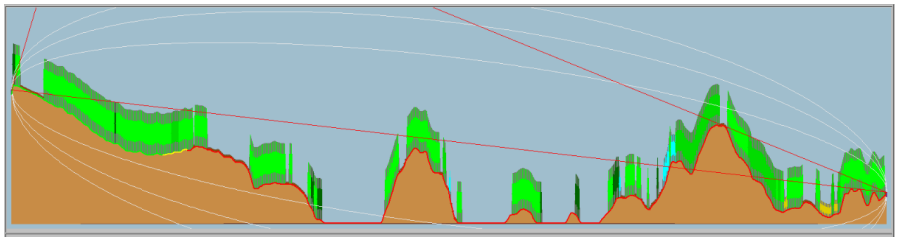


Figure 2: Distance Limitations

"Depending on terrain and atmospheric impairments, your mileage may vary!"

This computer simulation is an example of terrain blockage. A neighboring GMRS/Ham operator is **3.5 miles** away. GMRS communication is **impossible using 8 Watt** handheld radios and original antennas. Increasing antenna height, gain, and transmit power to 25 Watts does not improve the situation.



GMRS H2H*

N1XP - HOME (1)		(2) KC1JMH-Home	
Latitude	43.591067 °	Latitude	43.634561 °
Longitude	-70.689178 °	Longitude	-70.723311 °
Ground elevation	141.0 m	Ground elevation	104.0 m
Antenna height	1.7 m	Antenna height	1.7 m
Azimuth	330.41 TN | 344.77 MG °	Azimuth	150.38 TN | 164.75 MG °
Tilt	-0.41 °	Tilt	0.36 °

Radio system		Propagation	
TX power	36.99 dBm	Free space loss	100.37 dB
TX line loss	0.00 dB	Obstruction loss	49.78 dB
TX antenna gain	-3.00 dBi	Forest loss	0.00 dB
RX antenna gain	-3.00 dBi	Urban loss	1.00 dB
RX line loss	0.00 dB	Statistical loss	30.05 dB
RX sensitivity	-113.02 dBm	Total path loss	181.20 dB

Performance	
Distance	**5.563 km**
Precision	10.0 m
Frequency	449.990 MHz
Equivalent Isotropically Radiated Power	2.506 W
System gain	144.01 dB
Required reliability	99.000 %
Received Signal	-150.21 dBm
Received Signal	0.01 µV
Fade Margin	**-37.19 dB**